

**TWO SPECIES OF *LEUCOPIS* MEIGEN (DIPTERA: CHAMAEMYIIDAE)
PREDACIOUS ON THE RUSSIAN WHEAT APHID, *DIURAPHIS NOXIA*
(MORDVILKO) (HOMOPTERA: APHIDIDAE), IN NORTH AMERICA**

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Abstract.—Two species of *Leucopis* predacious on the Russian wheat aphid, *Diuraphis noxia* (Mordvilko), in North America are described. *Leucopis ninae* Tanasijtshuk is primarily known from the Palearctic Region, but has been recently introduced into the Nearctic. *Leucopis gaimarii*, n.sp., is endemic to the Nearctic Region.

Key Words: Chamaemyiidae, *Leucopis ninae*, *Leucopis gaimarii*, *Diuraphis noxia*, Russian wheat aphid

Two species of *Leucopis* Meigen (*s. str.*) (Diptera: Chamaemyiidae) preying on the Russian wheat aphid, *Diuraphis noxia* (Mordvilko) (Homoptera: Aphididae), in North America are described below. This publication is partly to provide names for further studies of these species. Their preimaginal stages have been studied by Gaimari (1993) and Gaimari and Turner (1996a, b). Efforts to introduce one species, the Palearctic *L. ninae*, into the Nearctic Region were undertaken by the USDA-APHIS-PPQ (Prokrym et al., in press). The other species is new to science and is endemic to the Nearctic Region, feeding on the introduced *D. noxia*, in addition to other aphid species.

Two *Leucopis* species other than *L. ninae* (*L. pallidolineata* Tanasijtshuk and *L. glyphinivora* Tanasijtshuk) are known to prey on *D. noxia* in the Palearctic Region (Tanasijtshuk 1986). *Leucopis pallidolineata* has been recorded only from the Palearctic, where it occurs from southern France to the Russian Far East. *Leucopis glyphinivora* is a Holarctic species widely distributed in the Palearctic, with Nearctic material also present in the National Museum of Natural His-

tory, Washington, DC, and the Canadian National Collection, Ottawa. Based on material in these collections, it is also widely distributed in the Nearctic. Both species are polyphagous, with the former recorded from 29 aphid species, and the latter from over 70.

MATERIALS AND METHODS

The material of *L. ninae* was primarily from the collection of the Zoological Institute of the Russian Academy of Sciences in St. Petersburg, Russia, which houses over 600 specimens of this species, including the holotype and 36 paratypes. Additional material was collected by researchers from the USDA and Agriculture Canada from various sites in the Palearctic, including a series cultivated by S. D. Gaimari. The material for studies of the new Nearctic species was received from S. D. Gaimari.

Analysis of male genitalia is essential for accurate identification of most species of *Leucopis*. Specimens were relaxed, and their last abdominal segments were removed and soaked in 20% KOH for 24 hours. After rinsing, they were drawn through alcohol, xylene, oil of cloves, and

mounted in Canada balsam or stored in glycerin. Genitalia were separated from pre-genital sclerites with probes, consisting of minutiae sharpened on a bar of marble and fixed to matchsticks. For closer examination and graphical representation of particular genitalic elements, some genitalia were further dissected.

Terminology follows that of McAlpine (1981). Following are some additional definitions and clarifications of terminology used in the present work. The term "ocellar plate" used in the description of the adult refers to an elevated area within the ocellar space, often extending forward through the anterior ocellus. The level of delimitation of this plate, its shape, size, and coloration may provide adequate taxonomic characters to distinguish some species of *Leucopis*, but not all of them. The OT (ocellar triangle) index represents the ratio of the distance between posterior ocelli and the distance between either posterior ocellus and the anterior ocellus. Frons width (when measuring its ratio to head width) is measured at the narrowest point, near the ocelli. Genal height is measured at the highest point. When evaluating frons coloration and abdominal spots, it should be noted that coloration may vary in intensity depending on angle of observation. Thus, abdominal spots clearly visible when inspected from behind may appear pale and even vanish when viewed from above.

Genitalic terminology basically conforms to McAlpine (1981) with the following exceptions: edite refers to the surstylus of McAlpine (1981), anterior paramere refers to the gonopod, posterior paramere refers to the gonostylus, and the phallus refers to the aedeagus.

LEUCOPIS NINAE TANASIJTSHUK
(Figs. 1–10)

Leucopis ninae Tanasijtshuk 1966: 234;
Tanasijtshuk, 1986: 272.

Male, female. Body length 1.8–2.8 mm.
Body light grey.

Head 1.4–1.6 times as high as long. Frons widened anteriorly, 2.6–3.0 times narrower than head. Ocellar plate drop shaped, almost level with front surface; two dark grey or dark brown stripes enveloping ocellar plate, not fusing over lunule. Cigar shaped longitudinal stripe sometimes noticeable on plate with anterior ocellus located near center of stripe; dark swellings sometimes visible between anterior and posterior ocelli. OT index 1.1–1.3. Frontal vitta lightly hairy. Antenna and arista black; 3rd arisal segment 2.5–4.0 times longer than 2nd. Eye height 3.5–4.6 times longer than genal height. Row of minute bristles on each gena; fore bristle most conspicuous. Palpi black.

Mesonotum.—Golden brownish lateral stripes extending behind last pair of dorsocentral (dc) bristles; dark grey median stripes reach first pair of dc bristles. Spaces between stripes commonly devoid of bristles. Two pairs of dc bristles.

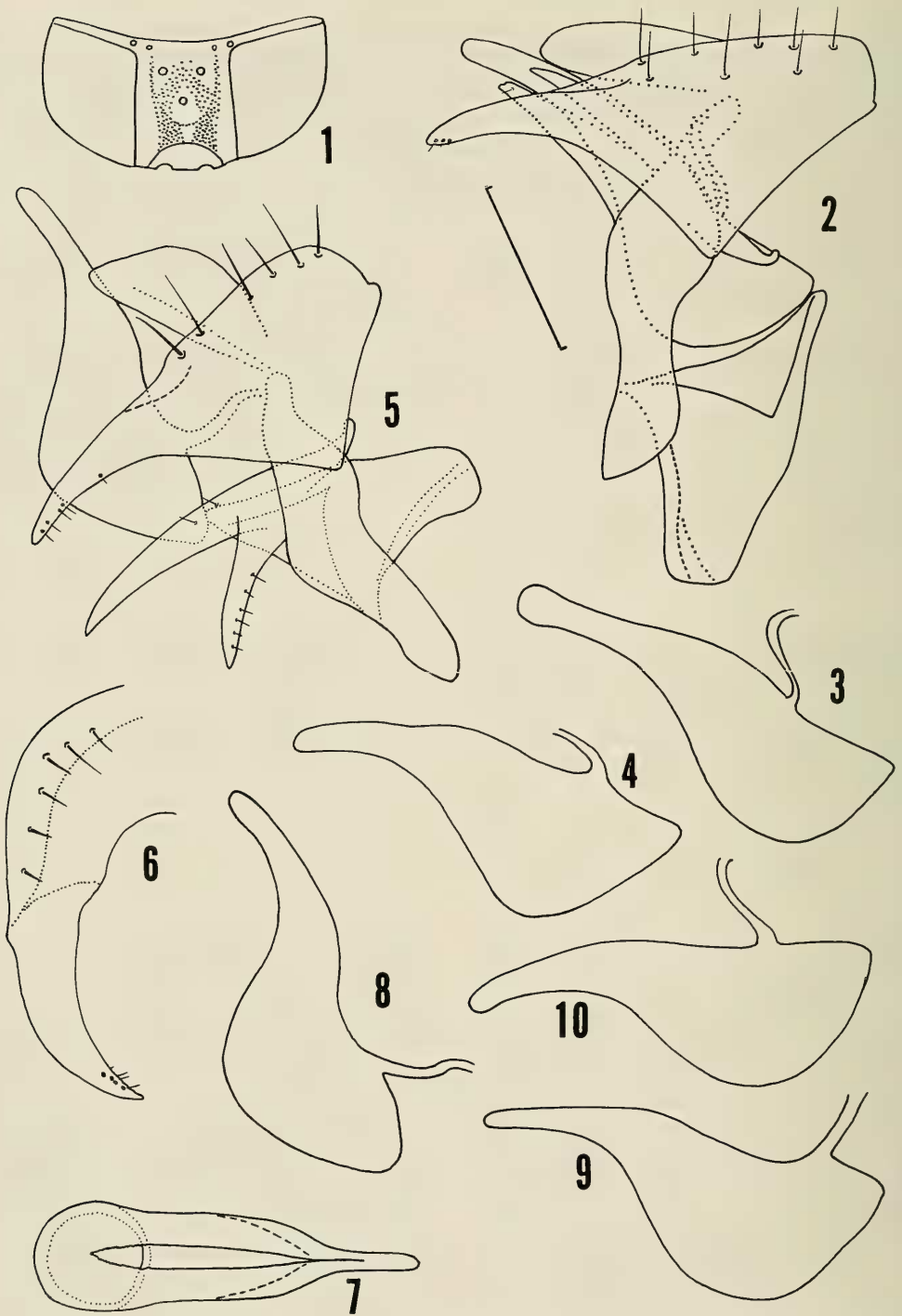
Legs.—Black; femoral apices, tibial bases, and certain tarsomeres yellow. 1st tarsomere on foreleg almost always completely yellow; middle and hind legs with at least two basal tarsomeres yellow.

Wing.—M and R 4+5 converging in the distal 1/3; ultimate section of Cu 1.1–1.3 times longer than m-cu.

Abdomen.—Syntergite 1+2 with grey spot covering at least 1/2. Two black spots on 3rd abdominal tergite, absent in some. Elongated dark regions of modified microtrichia present on lower edges of tergites 1+2 and 3.

Male genitalia (Figs. 1–10).—Epandrium with 5–10 pairs of large bristles posteriorly. Transfer to edites sharply outlined; edites narrow, relatively long in profile. Phallus swollen near base, smoothly tapering toward thick rounded apex.

Taxonomic notes.—The species is not identifiable by external appearance due to lack of sufficiently distinctive morphological characteristics and high variability in coloration. It is easily distinguishable using male genitalia, with its characteristically



Figs. 1-10. *Leucopis ninae*. 1, Head of male. 2, Male genitalia, holotype. 3, Variation of phallus, paratype. 4, Variation of phallus, Alma Ata (type-locality). 5, Male genitalia, Macedonia (specimen reared by Gaimari). 6, Same, edite from the front. 7, Same, phallus from below. 8, Variation of phallus, Macedonia. 9, Variation of phallus, Macedonia. 10, Variation of phallus, Montpelier, France.

shaped phallus which is expanded basally and has a thick rounded apex. However, genitalic characters are subject to high variability, which is evident from Figs. 2–10. In genitalic structure, *Leucopis impunctata* Roser is closest to *L. ninae*. Genitalic differences between these two species are negligible, but the species are readily differentiated by outward appearance.

Distribution.—Russia (North Caucasus), Ukraine, Transcaucasia (Armenia, Azerbaijan), Kazakhstan (Holotype male and paratypes from the Askay farm, environs of Alma-Ata), Turkmenia, Uzbekistan, Tadzhikistan, Kirghizia, Italy, Yugoslavia, Rumania, Turkey, Iraq, Iran, Afghanistan, Mongolia, and China. Introduced to USA (Arizona, California, Colorado, Idaho, Indiana, Kansas, Montana, Nebraska, New Mexico, Nevada, Oklahoma, Oregon, South Dakota, Texas, Utah, Washington, Wyoming) (Prokrym et al., in press) with unknown establishment. The species is well distributed in southern locations, but is not recorded north of 50° North Latitude.

Biology.—*Leucopis ninae* is one of the most common *Leucopis* species in the southern Palearctic. It inhabits highly variable biotopes ranging from deserts (Karakum, Kyzilkum) to mountain forests; however, it has not been recorded above 3000 m. It is commonly recorded from agroecosystems, and, along with *L. glyphinivora*, serves as a substantial component of the complex of entomophages in Middle Asia. The feeding range of the species is exceedingly wide. Despite the fact that its larvae are usually collected from aphids on angiosperms, they are also reported from adelgids, coccids and even psyllids (though in all probability they are feeding on aphids inhabiting the galls). Larvae of *L. ninae* are known to be predaceous on about 50 species.

***Leucopis gaimarii* Tanasijtshuk,
new species
(Figs. 11–19)**

Male, female. Body length 1.8–2.2 mm. Body light grey.

Head 1.5–1.65 times as high as long. Frons widened anteriorly, 2.5–3.0 times narrower than head. Ocellar plate nearly absent; plate not raised, distinguishable only by light grey coloration. Orbital welts light grey. Longitudinal dark grey stripes with blurred internal borders extending on sides of frontal vitta, converging above lunule. Light grey stripe passing through center of frontal vitta. Very short, light hairs conspicuous on frontal vitta and orbital welts. OT index 1.1–1.35. Ocelli of equal or nearly equal size, but sometimes anterior ocellus smaller than posterior ocelli. Antenna and arista black, 3rd arisal segment 3.5–4.5 times longer than 2nd, but at times this ratio is reduced to 2:1 (it seems likely that a mutation is responsible in such cases). Eye height 3.0–4.0 times longer than genal height. Row of minute bristles on each gena; one of the foremost bristles larger than others. Palpi black.

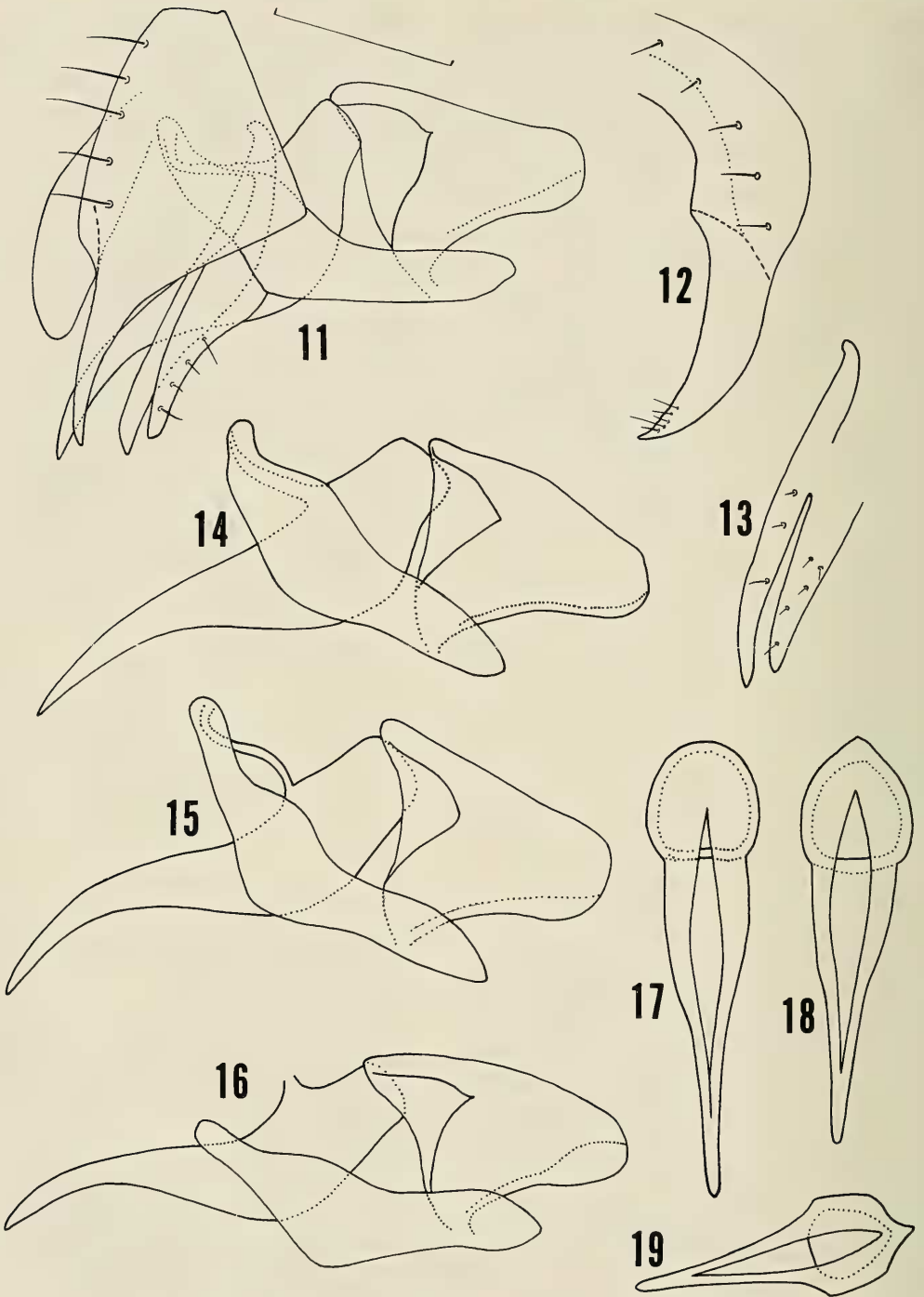
Mesonotum.—Lateral stripes of moderate width, dim brown, ending at posterior dc bristles. Dark grey median stripes extending over middle of mesonotum. Spaces between stripes devoid of bristles, at least to middle of mesonotum. Two pairs of dc bristles.

Legs.—Black; femoral apices, tibial bases, and certain tarsomeres yellow. First tarsomere on foreleg almost always completely yellow; middle and hind tarsi with 2–3 basal tarsomeres yellow.

Wing.—M and R 4+5 parallel or slightly converging in distal 1/2; ultimate portion of Cu 1.4–1.6 times longer than m-cu, sometimes ratio increased to 1.8:1.

Abdomen.—Syntergite 1+2 with dark grey spot, occupying nearly 2/3. Two grey spots with blurred borders may be present on 3rd tergite along with grey median longitudinal dots on 4th and 5th tergites. Spots and dots on tergites 3–5 may vary from pale to absent. Elongated dark regions of modified microtrichia present on lower edges of tergites 1+2 and 3.

Male genitalia (Figs. 11–19).—Epanthrium with thin edites in profile, 5–7 pairs



Figs. 11-19. *Leucopis gaimarii*, male genitalia. 11, General view, Garfield Co. 12, Same, edite from the front. 13, Same, parameres from below. 14, Variation of genitalia without epandrium and parameres, Garfield Co. 15, Variation of genitalia, Asotin Co. 16, Variation of genitalia, Asotin Co. 17, Phallus from below, Garfield Co. 18, Same, inclined. 19, Phallus, Asotin Co., strongly inclined.

of large bristles may be present on posterior surface of epandrium. In posterior view, edites appear significantly wider. Shape of hypandrium highly variable even within single population. Posterior parameres slightly longer than anterior ones. Shape of phallus distinctive, with relatively wide, nearly rectangular base in profile. In posterior and ventral views, characteristic constriction conspicuous (Figs. 17–19).

Taxonomic notes.—*Leucopis gaimarii* is widely variable in some parameters, such as the disappearance of spots on tergites 3–5 in many specimens, the shape of the hypandrium in profile, and the rounded or angular cut of the aedeagal apodeme. This variability is all the more remarkable because it is recorded within series cultivated in the laboratory and originated from common ancestors. It illustrates the concept of high intraspecific variability in *Leucopis*. In genitalic structure this species is closest to the Palearctic species *L. pallidolineata* Tanasijtshuk and especially *L. cerasiphila* Gomolitzkaja and Tanasijtshuk, but both of these Palearctic species differ from *L. gaimarii* in having a distinct ocellar plate. *Leucopis gaimarii* is also distinguished from *L. pallidolineata* by the darker lateral stripes of the mesonotum, presence of dark spots on the 3rd abdominal tergite (a character found in only part of the series of *L. gaimarii*), and the more rounded base of the phallus in *L. pallidolineata*. The genitalic structure in *L. cerasiphila*, particularly the shape of phallus, is similar to that in *L. gaimarii*, and a basic difference is the sharply pronounced ocellar plate in *L. cerasiphila*.

It seems plausible to make no distinction between these species on the grounds of similarity in genitalia; however, a serious barrier lies in the different structure of the ocellar plate as well as the fact that their habitats differ widely in ecological and geographical characteristics. *Leucopis gaimarii* is distributed northward at least to the state of Washington, and may possibly inhabit southern Canada as well. *Leucopis cerasiphila* possesses quite a limited distribution-

al area. It has been collected only in small numbers in Turkmenia and Southern Tajikistan, and is not reported from the vast collections gathered in Siberia, the Russian Far East, and Mongolia. Based on genitalic similarities and external morphology, I believe *L. cerasiphila* and *L. gaimarii* to be sister species, evidently originating due to geographic isolation. Without doubt both these species are near to *L. pallidolineata*.

Distribution.—Washington, Idaho and Utah, though the true distribution of this species is probably much wider.

Types.—Holotype: ♂, Prep. #7058, Washington, Asotin Co., 0.6 km west Anatone (on Mill Road), 1160 m, Aug. 1991, ex: swept off *Diuraphis noxia* infested wheat, *Triticum aestivum*, reared Mar. 1992, collector S. D. Gaimari. Deposited in the Illinois Natural History Survey, Urbana, IL. Paratypes: 33 ♂s, 35 ♀s, 12 ♂s with puparia, 16 ♀s with puparia, collected and reared with holotype; 51 ♂s, 78 ♀s, 9 ♂s with puparia, 24 ♀s with puparia, collected and reared from Washington, Garfield Co., Central Ferry, USDA-ARS Research Farm, 165 m, Jul. 1991, ex: swept off *Diuraphis noxia* infested cereal ryegrass, *Secale cereale*, reared Feb. 1992, collector S. D. Gaimari; 1 ♂, Washington, Lake Paha, 20.VII (19)20, collector R. C. Shannon; 1 ♂, Idaho, Moscow, 8.VIII (19)39, rotary trap, collector T. A. Brindley. 1 ♂, Utah, Salt Lake (City), 7.III (19)12, reared on aphids on *Elymus* leaves. Deposited in the Illinois Natural History Survey, the National Museum of Natural History, Washington, DC, the Zoological Institute of the Russian Academy of Sciences, St. Petersburg, and the Maurice T. James Entomological Collection, Washington State University, Pullman.

Biology.—The specimens reared in Asotin County were preying on *Diuraphis noxia* from *Triticum aestivum*. The specimens from Garfield County were on *D. noxia* from *Secale cereale*. The specimen from Salt Lake City was also reared on aphids from a graminaceous plant, *Elymus*.

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LITERATURE CITED

- Gaimari, S. D. 1993. Comparative life histories and morphology of the immature stages of three *Leucopis* spp. (Diptera: Chamaemyiidae), and methods for rearing *Leucopis*. M.S. thesis. Department of Entomology, Washington State University, Pullman, Washington. 120 pp.
- Gaimari, S. D. and W. J. Turner. 1996a. Immature stages of *Leucopis ninae* and two variant populations of *Leucopis gaimarii* (Diptera: Chamaemyiidae) feeding on Russian wheat aphid, *Diuraphis noxia* (Homoptera: Aphididae). Proceedings of the Entomological Society of Washington 98: 647–666.
- . 1996b. Larval feeding and development of *Leucopis ninae* and two populations of *Leucopis gaimarii* (Diptera: Chamaemyiidae) on Russian wheat aphid, *Diuraphis noxia* (Homoptera: Aphididae), in Washington. Proceedings of the Entomological Society of Washington 98: 667–676.
- McAlpine, J. F. 1981. Morphology and Terminology—Adults, pp. 9–63. In McAlpine, J. F., B. V. Peterson, G. E. Shewell, H. J. Teskey, J. R. Vockeroth, and D. M. Wood, eds., Manual of Nearctic Diptera, Volume 1. Monograph 27. Research Branch, Agriculture Canada, Ottawa. 674 pp.
- Prokrym, D. R., D. J. Nelson, G. S. Sauter, and C. J. Copeland. In press. Russian wheat aphid biological control project, FY 1994 project report. U.S. Department of Agriculture, Animal and Plant Health Inspection Service report.
- Tanasijtshuk V. N. 1966. New species of the genus *Leucopis* (Diptera, Chamaemyiidae) from south-eastern Kazakhstan. Trudy Zoologicheskogo Instituta Akademii Nauk SSSR 37: 233–236. (In Russian.)
- Tanasijtshuk, V. N. 1986. Silver-flies (Chamaemyiidae). Fauna of the USSR, new series 134, Diptera. Volume 14, 7. Zoological Institute of the Russian Academy of Sciences. Nauka Publishers, St. Petersburg. 336 pp. (In Russian.)